

# Verbal and nonverbal theory of mind development in three- and four-year-olds

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*Abstract*

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In the past three decades researchers have developed several tasks to measure theory of mind in young children. The current study administered one nonverbal theory of mind task and five verbal theory of mind tasks to a group of three-year-olds and a group of four-year-olds in order to investigate (1) how they perform on a nonverbal transfer task, (2) how the different verbal theory of mind tasks relate to each other, and (3) how the nonverbal transfer task relates to the verbal theory of mind tasks. The nonverbal theory of mind task was modified in a way that controlled children from passing this task by making three-way associations, using the behavioural rule that people look for objects where they last saw them, and using the situational cue of the actor disappearing from the scene to help predict the actor's behaviour. Results showed that both three- and four-year-olds changed their looking behaviour based on the beliefs of the actor in the nonverbal transfer task. Results furthermore showed that the different verbal theory of mind tasks used in this study were related to each other, and that some of these tasks were more difficult to pass than others. In addition, this study found that the nonverbal transfer task did not correlate to any of the verbal theory of mind tasks. Based on the results of the theory of mind tasks administered, it was argued that three- and four-year-olds have already developed a theory of mind, but fail more difficult theory of mind tasks because of task difficulties not related to theory of mind, most likely information-processing demands.

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## 1. Introduction

### *1.1 Historical perspective on theory of mind research*

Piaget was one of the first to investigate the child's understanding of the mind (e.g. 1929). He believed that young children, unlike older children and adults, do not understand the nature of thought (Piaget, 1929). Now, almost 80 years later, the child's understanding of the mind is still a lively area of cognitive developmental research (e.g. Southgate, Senju, & Csibra, 2007; Sodian & Thoermer, 2008). Research in this field, now known as the child's theory of mind, became especially popular early 1980s after Premack and Woodruff (1978) published a paper in which they claimed to have found evidence that chimpanzees have a theory of mind. They defined theory of mind as an ability to impute mental states—desires, emotions, beliefs, intentions and other inner states involved in human action—to self and others. Following this paper an experimental paradigm was developed by Wimmer and Perner (1983) that could test the presence of a theory of mind in children. Theory of mind is an important topic of research as the ability to impute mental states to others is indispensable when making sense of people's behavior, and consequently essential for social life (Wellmann, 1990).

Premack and Woodruff (1978) choose to call theory of mind a 'theory' for two reasons, first, because mental states are not directly observable and, second, because predictions can be made about the behavior of other persons with help of this system. For those reasons the theory of mind is very akin to a scientific theory where the child uses rules to determine the content of one's own and other person's minds. To determine the content of another person's mind the child has to be able to understand that other people hold beliefs about the world around them, and that these beliefs control their actions (Dennett, 1978). Although it seems simple to test this, in practice it is somewhat complicated to determine the presence of a theory of mind in children. For example, one cannot simply ask the child about another person's true beliefs. As Mitchell (1996) explains; if a child is shown a candy box and asked what another person believes is inside the box, the child will probably correctly respond by saying "candy". However, one cannot say for certain that the child has an understanding of the other person's mind based on these results. It could as well be the case that the child reports its own view of reality and not the beliefs of the other person, which would result in a similar answer. To test whether a child has a theory of mind it is therefore necessary to

employ a task in which the other person's beliefs are incongruent with reality; a so-called false belief task. An example of such a false belief task is a task designed by Wimmer and Perner (1983), here named the traditional transfer task.

### *1.2 The traditional transfer task*

In a famous study, Wimmer and Perner (1983) developed and tested a transfer task that was designed to determine the presence of a theory of mind in young children. In this study children were told a story that was enacted with dolls. In the story, a doll puts an object at a certain location and then leaves. Another doll then enters the scene, moves the object to another location and leaves again. The first doll returns to the scene and the experimenter asks the child to predict where the first doll will look for the object. To pass this test, children need to realize that the first doll does not act in accordance with reality, but in accordance with a mental representation of the world. Beside this, the child also needs to ignore its own representation of the world and predict the doll's actions based on its false representation. The results of this study showed that less than half of the four-year-olds tested answered correctly to this question while almost all six-year-olds answered correctly. From these results, the authors concluded that somewhere between the period of four to six years of age children develop a cognitive skill that allows them to understand that other people have beliefs and predict the actions of another person based on these beliefs. However, the failure of younger children on this test does not undoubtedly prove that younger children do not possess a theory of mind; there might be other reasons why younger children fail this test.

*Problems with the traditional transfer task.* There are several problems associated with the traditional transfer task. The first problem is that this task requires children to remember many details associated with the task, such as the first location of the hidden object and whether the protagonist saw the object being hidden or not. Young children might fail the traditional transfer test because they have a weaker memory than older children and therefore forget past thoughts, resulting in an incorrect prediction on the task. The second problem with the traditional transfer task is that, in order to pass the task, a certain level of linguistic competence is required of the children. It could be the case for instance that younger children misinterpret the test question 'Where will he look for the object?' as a request from the experimenter to help the protagonist find the object. The third problem with the traditional

transfer task is that the test is generally performed with inanimate objects that do not have minds. The reason that younger children fail the traditional transfer test might be a result of them not attributing a 'mind' to these inanimate objects while older children do. This is not the same as saying that younger children do not have a theory of mind at all; they might simply not apply it to inanimate objects such as dolls. A study by Perner, Leekam, and Wimmer (1987) investigated whether younger children fail the traditional transfer task because they have not sufficiently developed their memory yet. They showed that many younger children who remembered the main events of the story still made wrong belief attributions. These results suggest that younger children do not fail the traditional transfer task because they forget what has occurred in the story. They also investigated whether younger children fail the traditional transfer task because they misinterpret the test question. Results showed that changing the format of the test question in the traditional transfer task to make it less ambiguous did not increase correct response rates. A meta-analysis by Wellman, Cross, and Watson (2001) confirmed that the phrasing of the question in the traditional transfer test (using 'look', 'think/believe', 'say', 'know', or adding the temporal marker 'first') did not influence children's responses. However, it might still be the case that younger children have problems with the traditional transfer task because, in order to pass it, children need to have a certain level of linguistic competence, regardless of how the question is phrased.

### *1.3 Other verbal theory of mind tasks*

The traditional transfer task was developed to measure theory of mind in children, however, many other tasks have also been used to measure theory of mind in children. Some of these tasks were developed to overcome the problems of the traditional transfer task described above, others were designed to test different theory of mind abilities. The verbal tasks that are used in this study to measure theory of mind and theory of mind related abilities are described below.

*The non-animated transfer task.* Melinder, Endestad, and Magnussen (2006) developed a non-animated transfer task very similar in design to the verbal transfer task. In this task the child is presented with a wallet containing money and an empty milk box. The experimenter moves the money from the wallet to the milk box and subsequently asks the child where he or she thinks another child, that has not seen the money being transferred to the milk box, will



look for the money. This task does not require the child to attribute a ‘mind’ to an inanimate object, but to another child and differs therefore from the traditional transfer task. Another difference is that in the non-animated transfer task the other child is never present at the scene, it is therefore not necessary to remember what this other child did or did not see to pass the task, which is necessary in the traditional transfer task. Results of this study showed that 74 percent of the 4-, 5-, and 6-year olds predicted correctly that the child would search for the money in the wallet, suggesting that they understand that other people can have false beliefs. However, as the study did not report the responses to the non-animated transfer task per age group, further research is needed to investigate the exact age at which children generally pass this task.

*The unexpected content task.* Perner, Leekam, and Wimmer (1987) designed an unexpected content task to test the presence of a theory of mind in young children. In this task children are presented with a container and asked what they believe is in there, they are then shown that the container has another content than expected and asked what they believed was in the container before the experimenter opened it and what they believe another person, who has not seen the content, will think is in the container. The unexpected content task is similar to the non-animated transfer task in that it does not require children to make predictions about the beliefs of a doll or other inanimate object. It differs from the non-animated transfer task in that it requires children to think about their own past false belief as well as another person’s false belief. Generally, results show that most three-year-olds fail this task, while older children pass this task (Gopnik & Astington, 1988). The finding that three-year-olds generally fail this task supports the idea that younger children do not fail the traditional transfer task because they have difficulty attributing beliefs to inanimate objects; they also fail false belief tasks that require children to attribute false beliefs to themselves and other persons.

*The appearance-reality task.* The traditional transfer task and the unexpected content tasks suggest that children below the age of four lack a theory of mind. Similarly, three-year-olds children appear to have difficulties in distinguishing between reality and appearance. Several experiments have been developed in the past to investigate whether children can distinguish between reality and appearance (Flavell, 1986; Flavell, Flavell & Green, 1983). Generally, in these experiments children are shown deceptive objects that appear to look like one thing but really are something else (such as a sponge that looks like a rock) and are then asked what the

object really is and what it looks like. Although some three-year-olds pass these appearance-reality tasks, many fail it, answering that the object is really a sponge and also looks like a sponge. Older children generally do better on these appearance-reality tasks, answering correctly that the object looks like a sponge, but is really a rock. These studies show that children below the age of four have difficulty distinguishing between reality and appearance. Being able to make this distinction is very important for the development of a theory of mind because in order to understand other people's beliefs one needs to be able to understand that the same event can be represented differently by different people. The results of the appearance-reality task suggest that children below the age of four might fail false belief tasks such as the traditional transfer task because they are unable to hold two different representations of an event or object simultaneously.

*The perspective taking task.* Another theory of mind related task is the perspective taking task. The ability to take another person's perspective is vital to the development of a theory of mind, because, to understand the beliefs of another person, one needs to be able to understand that another person's beliefs can be different from one's own. Without this ability one's own beliefs would be interfering when making judgments about another person's beliefs. Children below the age of four may fail theory of mind tasks because they lack this ability. Although there are many variations to the perspective taking task, the child is generally presented with an image or object which is then placed in such a way that the child cannot see the object or image, but the experimenter can. The child is then asked whether the experimenter can see the object. To answer correctly, the child has to ignore his or her own perspective and take the perspective of the experimenter. This type of perspective taking has been referred to as "level-1" perspective taking and is generally passed by most three-year-olds and some two-year olds (Flavell, Everett, Croft & Flavell, 1981; Melinder, Endestad, & Magnussen, 2006). These studies suggest that the ability to take another person's perspective generally develops just before children start to pass other theory of mind tasks.

*Summary of the verbal theory of mind tasks.* Although many studies have used verbal theory of mind tasks to investigate theory of mind in young children, there is still much to learn on how these tasks are exactly related to each other. When looking at theory of mind, many studies combine the scores of different theory of mind tasks into a composite theory of mind score (e.g. Carlson, Moses, & Claxton, 2004; Charman, Baron-Cohen, Swettenham, Baird,

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Cox, & Drew, 2000). However, the relationship between these different tasks has still not been mapped out completely. More research comparing these different tasks is therefore needed.

#### *1.4 Nonverbal theory of mind tasks*

Up until the mid 1990's researchers investigating the presence of a theory of mind in young children often changed the traditional transfer task to demonstrate earlier competence and to find out why younger children failed this task. However, when changing the traditional transfer task, for instance by overtly stating the beliefs of the protagonist, there is always the possibility that the task measures a different concept than the original task. Clements and Perner (1994) therefore decided to design an experiment that could demonstrate knowledge of beliefs in young children, while using the same traditional transfer task. They administered the traditional transfer task to a group of children, but besides asking them where they believed the protagonist would search for the object, they also recorded where the children looked during the crucial moment in the story. Results showed that three-year-olds looked at the correct location in the task, showing an implicit understanding of belief, but lacked an explicit understanding of beliefs as they gave the wrong answer to the test question. Based on these predictive looking results, Clements and Perner (1994) concluded that three-year-olds must have some kind of implicit knowledge of false beliefs. In other words, children around the age of three have some kind of understanding of false beliefs, but cannot use that knowledge yet to make an explicit, elicited-response.

After the study of Clements and Perner (1994) was published, other researchers also started to use nonverbal tasks to test false belief understanding in young children. For instance, Southgate, Senju, and Csibra (2007) used a nonverbal transfer task to investigate whether two-year-olds were able to attribute mental states to other people. In their experiment they had a group of two-year-olds look at an actor that was positioned behind two boxes. An object was moved from one location to another in such a way that the actor falsely believed that the object was hidden in one of the containers. Results showed that a large majority of the two-year-olds gazed to the container where the actor believed the object was hidden, even though the children had seen that the object was actually positioned in the other location. These results suggest that children as young as two-years-old already attribute false beliefs to others.

One possible explanation why children at this age pass these nonverbal tasks, but fail the traditional transfer task is that children at this age have a theory of mind, but do not have the linguistic competency to understand and respond correctly to the test question of this task. Another explanation, given by Clements and Perner (1994), is that the verbal task requires a judgment while the nonverbal task is nonjudgmental. They argue that giving an elicited-response requires the child to make an explicit judgment, while giving a spontaneous response (by looking at a direction) does not, which could increase the tasks difficulty and might be a reason why younger children fail the verbal, but not the nonverbal transfer task.

Onishi and Baillargeon (2005) tested even younger children, namely 15-month-old infants on a nonverbal transfer task. During this task 15-month-old infants were shown an actor positioned behind two boxes. An object was moved in such a way that the actor held either a true or false belief about the position of the object. The actor then reached into one of the boxes, either into the one the actor believed the object was, or into the opposite one. They argued that children with a theory of mind would expect the actor to search in the location where the actor believed the object was. They furthermore argued that these children would look longer at the scene when the actor did not act according to its beliefs. This study is different in design from that of Clements and Perner (1997) and Southgate et al. (2007) in that it does not analyze where children anticipate the actor to search. Instead, the study investigates children's looking behavior when their expectations are violated. Results showed that the infants in the study looked longer at the scene when the actor did not act according to its beliefs, suggesting that they expected the actor to search at the location where it believed the object was hidden and not where the object was actually located. Based on these results Onishi and Baillargeon (2005) proposed that children are born with an innate ability to use other people's beliefs to make sense of human behavior.

*Alternative explanations for the nonverbal transfer task results.* The results of the study by Onishi and Baillargeon (2005) started a debate on the validity of nonverbal transfer tasks and the existence of an innate theory of mind module in infants. Perner and Ruffman (2005) argued that the results of Onishi and Baillargeon's study did not proof that infants can attribute false beliefs to other people because their results could be interpreted differently. The first alternative explanation they proposed was that infants might create a three-way association between the actor, object, and location. According to this theory, children look

shorter at the scene when the configuration between the actor, object, and location is similar to a configuration they have just witnessed. They argued that in these cases, children would look shorter at the scene because a similar combination would require less processing, and consequently a shorter looking time. The looking time results in the study by Onishi and Baillargeon were consistent with this *three-way association theory* and could therefore account for why younger children looked longer at the scene when the actor did not act according to its beliefs. According to this alternative explanation infants do not need to be able to understand false beliefs to pass this task, they only need to be able to form three-way associations. The results of the study by Southgate, Senju, and Csibra (2007) cannot be interpreted with help of the three-way association theory, because they used a predictive looking paradigm, recording the looking direction of the children in order to investigate where they expected the actor to search. This is recorded before the actor attends to either one of the locations and consequently any three-way associations formed do not influence the child's looking behavior at this time.

The second alternative explanation Perner and Ruffman (2005) proposed was that infants might use a *behavioral rule*, namely that people look for an object where they last saw it. This only requires the infant to understand that people who see an object at a location will search for it there and people who do not see an object at a location will not search for it there. The looking behavior results of the study by Onishi and Baillargeon (2005) and Southgate et al. (2007) are both consistent with this *behavioral rule* and could therefore account for their results. Using this rule does not require infants to understand that the actor has a false belief in its mind; they can simply apply it without any awareness of the existence of a mind.

A third alternative explanation proposed by Sodian and Thoermer (2008) is that infants predict the actions of an actor in nonverbal theory of mind tasks by using *situational cues*. They performed a study with 16-month-old infants that showed that infants' action predictions in nonverbal theory of mind tasks are based on the actor's presence or absence in the scene, regardless of whether this presence or absence influenced the beliefs of the actor. These results indicate that children might use the situational cue of the actor leaving the scene, and not necessarily the actor's beliefs, to predict the actor's behavior in nonverbal transfer tasks. This could explain the findings of the study by Onishi and Baillargeon (2005), however, not the findings of the study by Southgate et al. (2007) as the actor in this study

does not disappear from the scene during the belief induction phase, it only turns around. All of these critiques have to be taken in mind when using a nonverbal task to measure theory of mind in order to ensure that children do not pass the task by other means than applying a theory of mind.

There are still those that believe the results of the study by Onishi and Baillargeon (2005) do demonstrate that 15-month-old infants have a theory of mind and that critics give up the possibility that infants understand false beliefs too quickly. Leslie (2005), for instance, argues that evolving the behavioral rule that people look for an object where they last saw it has no advantage in human evolution. Csibra and Southgate (2005) also replied to the arguments of Perner and Ruffman by stating that there is currently not enough evidence to assume that infants are capable of making three-way associations. However, as it is still not clear whether infants and children use these three alternative ways to pass the nonverbal transfer task, it is still unknown whether infants and younger children possess an implicit theory of mind. What is therefore needed is a nonverbal transfer task that cannot be passed by other means than using a theory of mind.

### *1.5 Comparing verbal and nonverbal theory of mind measures*

To my awareness, there exists only one study that has compared nonverbal and verbal answers of normally developing children on a specific theory of mind task (e.g. Clements & Perner, 1994). That study suggested that an implicit, nonverbal, theory of mind develops at an earlier age than an explicit, verbal theory of mind. However, it is still largely unknown how nonverbal theory of mind tasks relate to verbal theory of mind tasks. Because more and more researchers are using nonverbal theory of mind tasks to measure theory of mind in young children it is important to enhance our understanding of how the nonverbal and verbal theory of mind tasks are related.

### *1.6 The developmental progress of theory of mind*

In addition to researching at what age theory of mind develops, it is also interesting to investigate how it develops. There are general two main views as to how theory of mind develops. The first view is the traditional view, known as the *cognitive deficit theory*, which

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states that children do not develop a theory of mind until they begin to understand that external reality can be represented internally (Perner, 1991). The cognitive deficit theory claims that once children begin to understand that reality can be represented internally, they swiftly move to a stage where they can represent beliefs. According to this stage theory, children do not have a theory of mind before they reach this 'theory of mind' stage.

The second view has emerged later and is called the *modular theory of theory of mind*, and states that theory of mind has a specific innate basis (Scholl & Leslie, 1999). According to this theory, children do not develop a theory of mind through one or more stages, but possess a theory of mind module that enables a person to represent mental states (Scholl & Leslie, 1999). This theory claims that younger children fail false belief tasks not because they are not able to attribute false beliefs to others, but because they have not developed themselves enough in other areas. One such area which has been proposed to limit young children's performance on theory of mind tasks is selection processing. It has been suggested that young children understand false beliefs, but are not able to choose the right content for the belief yet (Scholl & Leslie, 1999). Because beliefs generally tend to be in line with reality, 'true' beliefs are more salient and prioritized. Without an 'inhibitor' to adjust this automatic assignment of true beliefs to others in cases where a person holds a false belief, true beliefs will be assigned in all cases (Scholl & Leslie, 1999). As a consequence, younger children will always attribute a true belief to another person and fail theory of mind tasks.

Besides these two main theories of theory of mind, there are also some other intermediary theories, such as the 'theory theory' which states that theory of mind develops through several phases (Gopnik & Wellman, 1992). This theory falls somewhere in between the other two as it states that theory of mind abilities already emerge before children pass the traditional transfer task, however, at the same time it describes theory of mind development as a process that occurs through stages, and not as an innate ability. Further research is needed in order to get a better comprehension of how children develop a theory of mind, how other theory of mind related abilities develop, and what the influence of these abilities are on the development of theory of mind.

## 2. The aim of this study

This study will present one nonverbal theory of mind task and five verbal theory of mind tasks to a group of three- and four-year-olds in order to investigate how children perform on these different tasks, and how these tasks relate to each other. There are several reasons why this age group was chosen. The first reason for choosing three- and four-year-olds is that they generally manage to complete (either correctly or incorrectly) the verbal theory of mind tasks used in this study. Most of these tasks are too demanding for younger children and too easy for older children; hence three- and four-year-olds were chosen. Another reason why these two age groups were chosen is because previous research investigating theory of mind in young children found that an explicit theory of mind develops somewhere around the age of four (e.g. Wimmer & Perner, 1983; Perner, Leekam, and Wimmer, 1987). Clements and Perner (1994) have furthermore suggested that an implicit theory of mind already develops around the age of three. The results of these studies suggest that children around the age of three and four years begin to develop the cognitive abilities necessary to pass these theory of mind tasks, making them an interesting group to study. A final reason for choosing these two age groups is that many studies using nonverbal theory of mind tasks have tested these tasks out on infants and two-year-olds (e.g. Southgate, Senju, & Csibra, 2007; Surian, Caldi, & Sperber, 2007; and Onishi & Baillargeon, 2005). However, much is still unknown on how older age groups perform on nonverbal theory of mind tasks. Asking three- and four-year-olds to perform a nonverbal theory of mind task will therefore provide us with more information on how these age groups respond to this type of task. Hopefully, this will help enhance our understanding of the cognitive mechanisms underlying theory of mind.

The current study has several aims. The first aim is to test young children on a nonverbal transfer task that is very similar to the traditional transfer task, but which has been modified to account for the critique formulated with respect to prior nonverbal tasks. Critics of the nonverbal theory of mind task argued that children might be able to pass the nonverbal task by other means than having a theory of mind, namely by making three-way associations, using behavioral rules, or using situational cues. The nonverbal task used in this study does not have the three-way association problem because, as in the study by Southgate et al. (2007), children's expectations are measured by recording their anticipatory looking behavior. Anticipatory looking is not influenced by three-way associations as it is recorded *before* the



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actor attends to one side. Children might still make three-way associations, however, using this strategy will not help them pass the nonverbal task in this study, and can therefore not account for any possible findings. The nonverbal task in this study has also been modified in a way that discourages children from applying the behavioral rule that people look for an object where they last saw it. This is achieved by randomizing the location where the protagonist will go to. The protagonist does not always go to the location where it last saw the object, disconfirming the behavioral rule that people always look for an object at a place where they last saw it. Finally, the nonverbal task used in this study also prevents children from using the situational cue of the actor leaving the scene to predict the actor's behavior. This is achieved by keeping the actor visible to the child during the belief-induction phase on each trial. Just like in the study by Southgate et al. (2007), the actor does not leave the scene during the believe-induction phase, but only turns around. Because of this, children cannot use the disappearance of the actor during the belief-induction phase as a cue to predict the actor's behavior. As a result of these modifications, the nonverbal task used in this study limits the possibility that children pass this task by other means than using a theory of mind.

Another aim of this study is to investigate how different verbal theory of mind tasks relate to each other. Although many studies have used different verbal theory of mind tasks and have reported the ages at which children pass them, none have thoroughly investigated the relationship between the five different verbal theory of mind tasks used in this study. Because all of these tasks have been used in previous studies to assess the presence of a theory of mind in children, it is important to investigate how these tasks are related. Also, because the verbal theory of mind tasks used in this study measure different aspects of theory of mind, comparing the results of these tasks will hopefully enhance our knowledge of the mechanisms underlying the child's theory of mind.

A final aim of this study is to investigate how the traditional transfer task relates to a similar nonverbal transfer task. These tasks are very similar in structure, however, one requires the child to make a spontaneous nonverbal response (look in one direction) while the other requires the child to make an elicited-response (answer the test questions). This study will also investigate how the nonverbal transfer task is related to the other verbal theory of mind tasks used in this study. More and more researchers are using nonverbal tasks to measure theory of mind in young children and infants; however, it is still unclear whether these

nonverbal tasks measure the same construct as the verbal theory of mind tasks. Comparing the results of the nonverbal transfer task with the verbal theory of mind tasks will hopefully shed some light on the relationship between these different measures of theory of mind and enhance our understanding of how theory of mind develops.

### 3. Method

#### 3.1 Participants

Participants were 40 preschoolers from Oslo, recruited through day care centers and by mail. The sample included 20 three-year-olds (10 female;  $M = 40$  months,  $SD = 2.1$ ) and 20 four-year-olds (11 female;  $M = 51$  months,  $SD = 2.4$ ). Three additional four-year-olds were excluded from the study due to poor attention in the nonverbal task. The study was approved by the local ethical committee, and written, informed consent was obtained from all parents or guardians. All parents and guardians were given 100 Norwegian kroner (NOK) to compensate for travel expenses.

#### 3.2 Design

Each participant was tested in two different sessions about 10 days apart ( $M = 11.78$  days,  $SD = 7.12$ ). In the first session, a nonverbal transfer task was administered. In the second session a traditional transfer task, a non-animated transfer task, an unexpected content task, an appearance-reality task, and a perspective taking task were randomly administered.

#### 3.3 Measures

*The nonverbal transfer task.* During the nonverbal transfer task the child was seated at approximately 150 centimeter from the scene. Gaze was measured using a Tobii X50 near infrared eye tracker. The complete scene was 120 centimeter wide and 45 centimeter high ( $43.6^\circ_{\text{width}} \times 17.1^\circ_{\text{height}}$ ) and contained two containers (one blue and one yellow) that were 21 centimeter wide and 13 centimeter high ( $8.0^\circ_{\text{width}} \times 5.0^\circ_{\text{height}}$ ). The containers could open so that an object could be hidden in them; each box was positioned 19 centimeter from the center of the scene. The scene also contained a red wall (that served as an occluder for the doll)

positioned in the center of the scene that was 23 centimeter wide and 16 centimeter high ( $8.8^\circ_{\text{width}} \times 6.1^\circ_{\text{height}}$ ), and an open elevator in which the human-like doll could move up (so it was visible to the child) and down (so it was hidden behind the red wall). The task was acted out live with several human-like dolls which were 18 centimeter wide and 28 centimeter high ( $6.9^\circ_{\text{width}} \times 10.7^\circ_{\text{height}}$ ) and a small puppet, that was 8 centimeter wide and 10 centimeter high ( $3.1^\circ_{\text{width}} \times 3.8^\circ_{\text{height}}$ ), and looked like a young deer ('Bambi').

The session included two familiarization trials and eight test trials. On the eight test trials, the story begins by introducing the child to one of the human-like dolls and Bambi. Following this, the doll asks Bambi to move from the center of the scene into one of the two containers. Bambi follows these instructions and moves into the container pointed out by the doll. The doll watches Bambi move into the container. In the true belief trials, the doll then keeps facing the scene with the two containers, while in the false belief trials the doll turns around (see Figure 1). Following this, Bambi moves from the original container to the container on

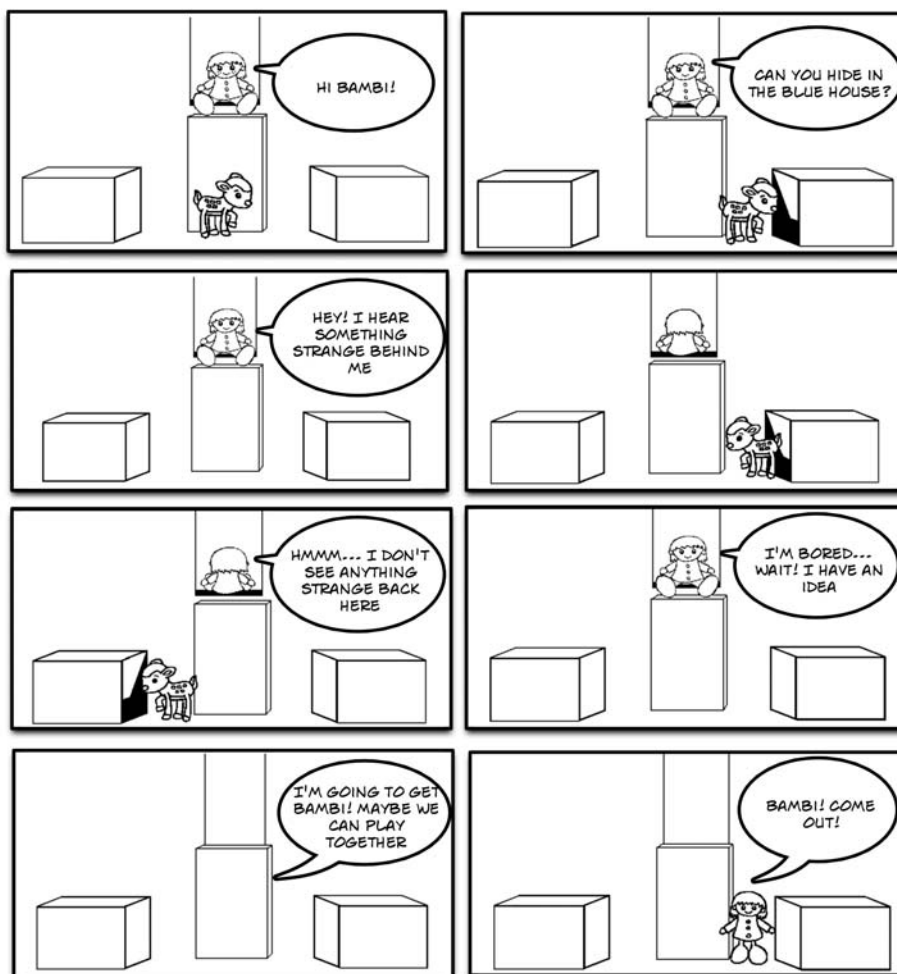


Figure 1. *The storyline of a false belief trial in the nonverbal transfer task.*

the other side. The doll witnesses this transfer of location in the true belief trials, but not in the false belief trials as it is still turned around. After Bambi changes locations, the doll turns around again so it is facing the scene (in the false belief trials) or the doll stays sitting (in the true belief trials). The doll then moves down using the elevator (so it is hidden behind the red wall) and tells the child it is going to get Bambi. After approximately 2-3 seconds, the doll appears at the container where Bambi is positioned, or at the container where Bambi was originally sent to.

The eight test trials were preceded by two familiarization trials in which Bambi does not change location and where the doll always went to the correct location to find Bambi. These familiarization trials were performed to let the child get familiar with the test situation and to clarify the goal of the doll (to find Bambi) to the child. All children were shown the same eight test trials in a random order. Whether or not the doll could see Bambi transfer locations and thus had a false or true belief about the location of Bambi was counterbalanced between the trials. After every 2-3 trials the human-like doll was replaced by a different doll to maintain the child's attention. Also, a short break was held after the first four test trials before continuing with the last four to maintain the child's attention throughout the eight test trials.

*Data analysis of the nonverbal transfer task.* In the nonverbal transfer task, the child's anticipatory looking behavior was recorded with the help of an eyetracker. It was expected that children with a theory of mind would anticipate the doll to search at the location where it *believed* Bambi was located, regardless of the actual location of Bambi. It was furthermore expected that children without a theory of mind would anticipate the actor to search at the location where Bambi was *actually* located, regardless of whether the actor believed the doll was located there or not. Children without a theory of mind were therefore expected to look at Bambi's location in the true, as well as the false belief trials. Children with a theory of mind were expected to look at Bambi's location in the true belief trials, but at the opposite location in the false belief trials. For each child, the video with the child's looking behavior was exported and analyzed frame by frame (every 20 milliseconds) in the video analysis program VirtualDub. For each trial, it was recorded where the child fixated its gaze at during the time the doll was hidden behind the occluder. A gaze fixation had to last at least two seconds to be included and only the first fixation was recorded. Only fixations occurring in the two areas

indicated in Figure 2 were included, fixations at irrelevant areas (such as the top of the scene) were thus not analyzed.



Figure 2. An overview of the relevant looking areas in the nonverbal transfer task.

For each trial, it was analyzed whether the child's first fixation was at the location where Bambi was hidden, or at the opposite location. For both the true and false belief trials the percentage of first fixations made by the child that were directed at Bambi's location was then calculated, from here on named the *fixation score*. These two *fixation scores*, one for the true belief trials and one for the false belief trials, were then compared to analyze whether the children looked more at Bambi's location in the true belief trials than in the false belief trials.

To be able to compare the nonverbal task results with the results of the verbal tasks, a different score was calculated, from here on named the *nonverbal score*. Each child received a score of zero or one, based on the child's individual looking behavior. The child received one point, and thus passed the nonverbal task, if he or she had more first gaze shifts towards Bambi's location in the true belief trials than in the false belief trials. The child received no points, and thus failed the nonverbal task, if he or she had less or a similar amount of first gaze shifts towards Bambi's location in true belief trials than in the false belief trials.

*The traditional transfer task.* The traditional transfer task (adopted from Clements & Perner, 1994) was acted out live with two cups with lids (one orange and one blue), a penguin doll (Pingu), a bird doll (Anne), and a small toy fish. The cups were positioned on a table at which the child was sitting. The experimenter then either told the false belief or true belief story. In the false belief story the child sees Pingu putting a fish (that he wants to eat later) in one of the cups. He then yawns and moves to another location to sleep. The experimenter then asks the child if he or she remembers where the fish is located (the first control question). Following this Anne enters the scene. Anne finds the fish, moves it to the other cup, and then disappears again. By that time the experimenter asks the child another three control questions ('Do you remember where Pingu put the fish?', 'Where is the fish now?', and 'Did Pingu see the fish being moved?'). Then Pingu wakes up, moves back to the scene, and tells the child that he is going to get his fish because he is hungry. The experimenter then asks the child the action prediction question; 'Where do you think Pingu will look first?', and the justification question: 'Why do you think he will look there first?'. If the child answered incorrect to any of the control questions the story would be repeated until the child answered the control questions correctly (with a maximum of three trials). If the child still answered the control questions incorrectly on the third trial the whole trial was counted as invalid. The true belief story (which served as a control condition) was similar to the false belief story except for one detail, in this version of the story Anne enters the scene before Pingu goes to sleep and consequently Pingu sees the fish being moved to the other cup. Each participant was told both the false belief and true belief story, in a counter-balanced order. The child passed this task and received one point if he or she answered all questions correctly (by telling or pointing) for both the false belief and true belief condition.

*The non-animated transfer task.* In the non-animated transfer task (adopted from Melinder, Endestad, & Magnussen, 2006), the experimenter put an empty milk-box and a wallet with money on the table. The experimenter then opened the wallet and said: "Look, there are some coins inside this wallet. But now, I do something strange. I put all of the coins into this milk-box." Subsequently, the experimenter took the money out of the wallet and put it in the milk-box and then continued: "When you have left this room, another child will enter the room. Where do you think that child will look for the coins?" The child passed this task and received one point if he or she answered that the other child would look in the wallet (or if the child pointed to the wallet).

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*The unexpected content task.* In this task (adopted from Perner, Leekam, and Wimmer, 1987) the children were shown a candy box (“Smarties”) and asked what they believed was in the box. The experimenter then opened the candy box and showed the child that it was filled with screws instead of candy. The screws would be put back in the box and the experimenter would ask the child the first experimental question: “Before I opened this box, what did you believe was in there?” All answers referring to candy were considered correct. The experimenter would then ask the child the second experimental question: “When you have left this room, another child will enter the room. What do you think that child will believe is in the box?” Once again, all answers related to candy were counted as correct. The child passed this task and received one point if it responded ‘candy’ to the two experimental questions. The child received half a point if it only correctly answered one question.

*The appearance-reality task.* In the appearance-reality task (adopted from Flavell, 1986) the experimenter presented the child with a doll that looked like a penguin but was actually a bear dressed up like a penguin. The experimenter showed the child the penguin and asked: “What is this?” All answers related to penguin were counted as correct. If the child did not know the name of the animal the experimenter told the child that the animal was called a penguin. Next, the experimenter would say: “But look what I do now!” While saying this, the experimenter removed the penguin suit, revealing that the doll was really a teddy-bear. The child was then asked: “So what is this?” All answers related to bear were counted as correct. The experimenter then put the penguin dress back on the bear and asked the child one reality question (“What is this really, a penguin or a bear?”) and one appearance question (“What does it look like, a penguin or a bear?”) of which the order was counterbalanced between the children. This task was passed and awarded with one point if the child answered correctly to both the appearance and reality question.

*The perspective taking task.* In this task (adopted from Melinder, Endestad, & Magnussen, 2006) an obstacle (a package of paper napkins) was placed on the centre of the table. The child was then given a small blue wooden block and asked to place the block on the table, but out of sight from the experimenter. The experimenter turned around and the child was instructed to place the block on the table so that the experimenter would not be able to see it when turning back around again. The child passed this part of the task if he or she put the

block on the table out of sight of the experimenter (behind the obstacle). In the second part of this task, the experimenter took the wooden block and told the child that he or she had to tell whether the experimenter could see the block. The experimenter would then place the block at three different locations, one time under the table, one time on the table behind the obstacle so that only the child could see it and one time on the table in front of the obstacle so that the block was only visible to the researcher. Each time the child was asked whether the researcher could see the wooden block. The child passed this part of the task if he or she answered all three questions correctly. The child was given one point if it passed both parts of the task and half a point if it only passed one part.

## 4. Results

### 4.1 Nonverbal response

The first aim of this study was to investigate how three- and four-year-olds perform on a modified nonverbal theory of mind task. During the familiarization trials, 14 of the 20 three-year-olds, and 18 of the 20 four-year-olds looked consistently at the correct side. The other eight children looked either at both directions, or into the wrong direction. However, because a preliminary analysis showed that these children did not do significantly worse on the test trials, they were not excluded from further analysis. The children's *fixation scores* (the percentage of first fixations at Bambi's location) were analyzed using a two-way analysis of variance with age and belief type as factors. A significant main effect (see Figure 3) was found for belief type ( $F(1,76) = 6.66, p < .05, \eta^2 = .081$ ), indicating that the children looked more often at the location of Bambi in the true belief trials ( $M = 73.97, SD = 24.89$ ) than in the false belief trials ( $M = 57.78, SD = 31.31$ ). No main or interaction effects were found with age as a factor.

Analysis of the *nonverbal score* of the children showed that 40 percent of the three-year-olds, and 70 percent of the four-year-olds had a looking behavior pattern consistent with a theory of mind (they looked more at Bambi in the true belief trials than in the false belief trials), and thus passed the nonverbal task (see Figure 4). More four-year old passed the nonverbal task than three-year-olds, however, although indicating a trend, this difference was not significant,  $t(38) = -1.95, p > .05, d = .062$ .



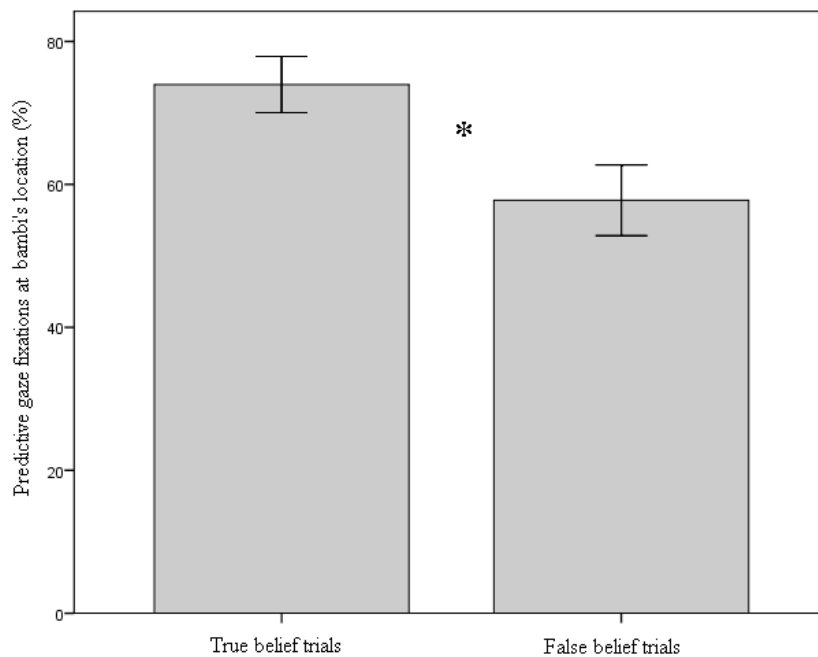


Figure 3. *The fixations scores on the true and false belief trials. Error bars represent standard errors. \* Indicates a significant difference ( $p < .05$ ).*

#### 4.2 Verbal responses

The second aim of this study was to investigate how three- and four-year-olds perform on five different verbal theory of mind tasks and to explore how these tasks relate to each other.

Figure 4 summarizes the results of the different theory of mind tasks. The effect of age on the verbal theory of mind tasks was examined using a two-way analysis of variance with the score on each task as a within-subjects factor and age as a between-subjects factor. As can be seen in Figure 4 there was a main effect of age ( $F(1,34) = 4.39$ ,  $p < 0.05$ ,  $\eta^2 = .114$ ), with the four-year-olds scoring better on the verbal theory of mind tasks than the three-year-olds. A main effect for task was also found ( $F(4,136) = 19.67$ ,  $p < 0.05$ ,  $\eta^2 = .367$ ). Post-hoc tests (t-test,  $p < .05$ ) revealed that the children's scores on all of the verbal tasks were significantly different from each other, except for the score on the non-animated transfer task and the unexpected content task, and the scores on the appearance-reality task and the perspective taking task.

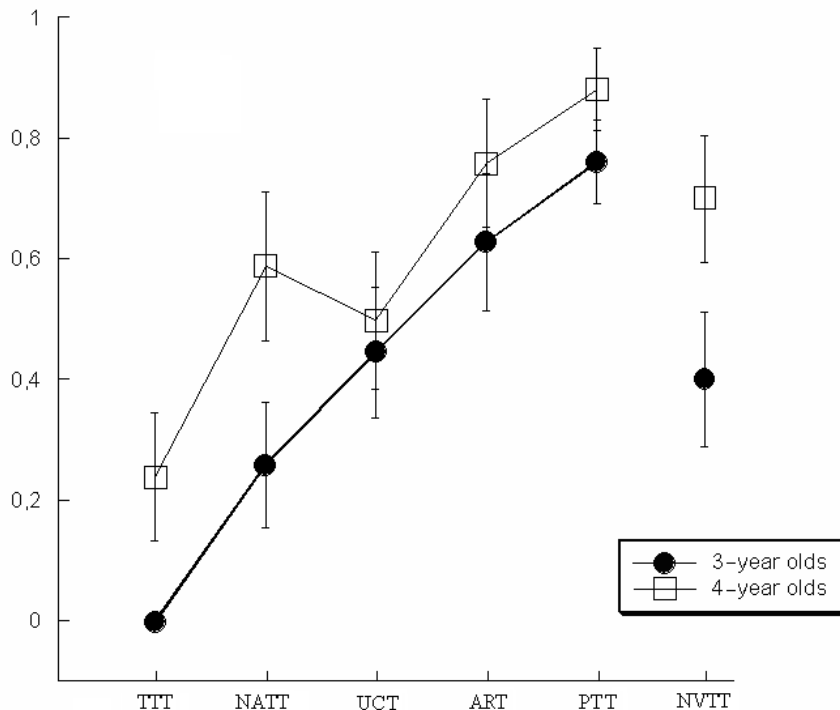


Figure 4. Average score per age group on the different theory of mind tasks. *TTT* is the traditional transfer task, *NATT* is the non-animated transfer task, *UCT* is the unexpected content task, *ART* is the appearance-reality task, *PTT* is the perspective taking task, and *NVTT* is the nonverbal transfer task. Error bars represent standard errors.

To investigate the relations between the different verbal theory of mind tasks, correlations were computed between the scores while controlling for age. A significant correlation was found between the non-animated transfer task and the unexpected content task ( $r(34) = .42, p < .05$ ) as well as the unexpected content task and the perspective taking task ( $r(34) = .37, p < .05$ ). The scores on the other tasks were not reliably correlated. However, significance might not have been reached due to the low variability in response scores on some of the theory of mind tasks (see Fig. 4). For that reason, a new analysis was carried out in which two groups were formed, one high-scoring group composed of the children who received one point in the unexpected content task and one low-scoring group composed of the children who received no points on this task. The unexpected content task was chosen for this split because this task was of average difficulty; around half of the children failed this task while the other half passed it. It was then tested whether the high-scoring group on the unexpected content task also scored higher on the other verbal theory of mind tasks. Results indicated that the high-scoring three-year-olds scored significantly higher on the other verbal theory of mind tasks ( $M = 2.07, SD = 0.84$ ) than the low-scoring three-year-olds ( $M = 1.28, SD = 0.83, p < .05, d = .95$ , one-

tailed t-test). A similar result was found for the four-year-olds; those in the high-scoring group scored significantly higher on the other tasks ( $M = 3.29$ ,  $SD = 0.76$ ) than those in the low-scoring group ( $M = 2.00$ ,  $SD = 0.65$ ,  $p < .05$ ,  $d = 1.82$ , one-tailed t-test). These results show that children who passed the unexpected content task did better on the other theory of mind tasks as well, demonstrating a clear relationship between the different verbal theory of mind scores.

#### *4.3 Relationship between the nonverbal and verbal theory of mind tasks*

A third aim of this study was to investigate how the nonverbal transfer task relates to the verbal theory of mind tasks. First it was analyzed whether the children's looking behavior on the nonverbal transfer task was correlated to the children's score on the traditional transfer task. Correlation analysis showed that the traditional transfer task was not correlated to the nonverbal transfer task ( $p > .05$ ). However, a likely reason why no correlation was found between the verbal and nonverbal transfer task is that not so many children passed the verbal transfer task (no three-year-olds and only twenty percent of the four-year-olds passed this task). Another analysis was performed to investigate whether the nonverbal transfer task was correlated to the verbal theory of mind tasks. Two groups were formed, one composed of the children that passed the nonverbal transfer task and one composed of the children who failed this task. Results showed that children who passed the nonverbal task did not score significantly higher on the verbal tasks than children who did not pass the nonverbal task (t-test,  $p > .05$ ). Correlation analysis furthermore showed that the nonverbal task was not correlated to any of the verbal theory of mind tasks (all  $p > .05$ ).

### **5. Discussion**

Several studies have been carried out over the past few decades in order to investigate how and when theory of mind develops in children. Many of them have used nonverbal theory of mind tasks to investigate whether a theory of mind is present in infants and young children. Some of these studies claim to have found evidence suggesting infants possess a theory of mind (e.g. Onishi & Baillargeon, 2005). However, others argue that these nonverbal tasks can be passed without using a theory of mind (e.g. Perner & Ruffman, 2005). Even though many of these studies have been performed on infants and young children, it is still largely unknown

how older children perform on these nonverbal theory of mind tasks that often use eye-tracking as a mean to determine whether a child or infant possesses a theory of mind. The present study aimed to complement the existing theory of mind literature by administering an altered version of the nonverbal transfer task to a group of three- and four-year-olds. This nonverbal transfer task was almost identical to the traditional transfer task, and its design limited the possibility that children passed it by other means than using a theory of mind. Furthermore were five verbal theory of mind tasks administered of which the results were compared to the nonverbal transfer task and to each other in order to investigate the relationship between the different tasks. The three main aims of this study were (1) to investigate how three- and four-year-olds perform on a modified nonverbal transfer task, (2) to describe the relationship between the different verbal theory of mind tasks used in this study, and (3) to explore how the nonverbal transfer task relates to other verbal theory of mind tasks. The conclusions that follow from the results of this study are discussed below.

### *5.1 Three- and four-year-olds' nonverbal theory of mind*

Results of the nonverbal transfer task showed that children looked more at the position where Bambi was currently hiding in both the true and false belief trials (see Figure 3). This result was not unexpected, since the presence of Bambi at one location probably made that location more attractive to look at. However, when the fixation scores were compared between the true and false belief trials, it was found that children looked significantly more at Bambi's location in the true belief trials compared to the false belief trials. Whether or not the doll in the story had seen that Bambi moved to another location thus had a significant effect on the looking behavior of the children. Children expected the actor to move to Bambi's original hiding location more often when the doll 'believed' that Bambi was still there than when it 'believed' that it was at the other location. Both the three- and four-year-olds showed this behavior pattern. Critics of previous nonverbal theory of mind tasks argued that children and infants may pass these tasks by other means than using a theory of mind. This study modified the nonverbal transfer task to account for these critiques.

The nonverbal transfer task was modified in such a way that discouraged children from using the behavioral rule "people look for an object where they last saw it". In half of the trials the children in this study witnessed the doll going to the wrong location, disconfirming this

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behavioral rule several times. As a consequence, the reported results were probably not caused by children using this behavioral rule. This study was designed in way that enforced the idea that people do not always look for an object where they last saw it. Children should therefore not have used this rule to predict the actor's behavior. The results of the nonverbal task are therefore probably not the result of children using this behavioral rule.

The children of this study could also not have passed this task by making three-way associations since the results are based on anticipatory looking behavior. Perner and Ruffman (2005) argued that the infants in the study by Onishi and Baillargeon (2005) may have passed the task by forming three-way associations between the actor, object, and location of the actor. They argued that these three-way associations were formed during the familiarization trials, and later activated during the test trials, influencing the looking behavior of the infants. More specifically, they argued that the children would look longer at the actor when the actor-object-location configuration was different from the one just encoded in the familiarization trial, and shorter when the actor-object-location configuration was similar to the one in the familiarization trial. This study used a similar predictive looking behavior paradigm as the study by Southgate, Senju, and Csibra (2007), recording the child's looking behavior at the moment the doll disappeared behind the occluder. This measure is not influenced by three-way associations as it is not based on looking times but the looking direction of the child. Furthermore was the looking direction of the child measured before the doll went to one of the locations, and therefore independent of any possible three-way associations formed by the child. Thus, because children's predictive looking behavior was used to measure theory of mind, and not violation of expectation, the three-way association theory cannot account for the findings of this study.

Another critique of nonverbal theory of mind studies is that the disappearance of the actor in the false belief trials might cue the child and consequently influence its looking behavior. This task was modified so that the actor never disappeared from the scene during the belief-induction phase. Similarly as in the study by Southgate, Senju, and Csibra (2007), the actor does not disappear, but only turns around during the belief-induction phase. The actor disappearing from the scene could therefore not have served as a cue for the child to predict the actor's behavior. Accordingly, the results of the nonverbal theory of mind task used in this

study cannot be explained by the children using the situational cue of the actor leaving the scene.

The children of this study changed their looking behavior based on the beliefs of the human-like doll. The nonverbal transfer task was modified to minimize the possibility that children passed it by other means than applying a theory of mind. The results of this study therefore indicate that three- and four-year-olds understand that an actor can have a false belief and that its behavior can be influenced by this belief. These findings replicate the results of the study by Clements and Perner (1994), showing that three- and four-year-olds have a theory of mind. The results of this nonverbal transfer task thus shows that three- and four-year-olds can impute a false belief to an actor and predict its behavior based on this belief.

### *5.2 The relationship between the different tasks*

A comparison of the different tasks used in this study showed that the unexpected content task was correlated with the non-animated transfer task as well as the perspective taking task and that children who passed the unexpected content task tended to score better on the other verbal tasks than children who did not pass this task. These findings suggest that the verbal tasks used in this study are measuring a similar construct, namely the presence of a theory of mind. This study found no significant relationship between the nonverbal transfer task and the traditional transfer task. This lack of correlation may have been caused by the flooring effects of the traditional transfer task, however, the nonverbal transfer task was not correlated with any of the other verbal tasks either. These results suggest that there is no relationship between the nonverbal transfer task and the verbal theory of mind tasks. This idea is furthermore supported by the finding that performance on the nonverbal task was not related to the total score on the verbal theory of mind tasks. One possible way to interpret these results is to suggest that the nonverbal theory of mind task and/or the verbal theory of mind tasks do not measure theory of mind, and consequently do not correlate. However, I would like to argue that these tasks do measure theory of mind, but that no correlation is found between the nonverbal and verbal tasks because the results on these tasks are highly dependent on other, non theory of mind related abilities that differ between the tasks.

The results of the traditional transfer task and the nonverbal transfer task support this idea. Around half of the children passed the nonverbal transfer task, but failed the traditional transfer task which measures the same theory of mind abilities, namely the ability to impute a false belief to another agent and to predict the agent's behavior based on its beliefs. It is not likely that the children that passed the nonverbal transfer task suddenly lack a theory of mind when tested on the traditional transfer task. The only other logical explanation is therefore that the children that passed the nonverbal theory of mind task do have a theory of mind but that they failed the traditional transfer task because this task requires some additional, non theory of mind related, abilities. One main difference between these tasks is that verbal task requires the child to make an elicited-response, while the nonverbal task requires the child to make a spontaneous response. Scott and Baillargeon (in press) argued that children may have difficulty with elicited-response tasks such as the traditional transfer task because their limited information-processing abilities cannot process the false belief representation and response-selection process simultaneously. Spontaneous response tasks such as the nonverbal transfer task do not require children to make an explicit response and are therefore cognitively less demanding. As a consequence, no correlation may have been found between the nonverbal and verbal tasks as there are other factors beside theory of mind, such as linguistic abilities and cognitive processing skills, which influence the outcomes of these tasks. The verbal theory of mind tasks all require a similar, elicited, response, which could explain why a relationship was found between these tasks, but not between the nonverbal transfer task and the verbal theory of mind tasks.

### *5.3 The developmental trajectory of theory of mind*

The results of this study showed that four-year-olds scored significantly better on the verbal theory of mind tasks than the three-year-olds. These results confirm the findings of previous studies showing that four-year-olds do generally better on verbal theory of mind tasks than three-year-olds (e.g. Clements & Perner, 1994; Flavell, Flavell & Green, 1983; Gopnik & Astington, 1988). The results of this study furthermore showed that three- and four-year-olds passed some theory of mind tasks, but failed others. Some of the theory of mind tasks used in this study were thus easier to perform than others which could shed some light on the developmental trajectory of theory of mind.

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Most of the children in this study passed the perspective taking task which shows that children at this age understand that people can have a different perspective of the world from themselves. They also passed the appearance-reality task, which demonstrates that they can hold two different mental representations at the same time and are able to distinguish between an external (what the object looks like) and internal (what the object really is) representation.

The results of the unexpected content task and the non-animated transfer task showed that around half of the children in this study understood that reality can be distinct from one's own (past) beliefs as well as the beliefs of another person and that a person's behavior can be influenced by his or her beliefs. Scott and Baillargeon (in press) suggested that young children may fail theory of mind tasks not because they have difficulty representing false beliefs, but because they have trouble inhibiting their own knowledge of reality. These tasks showed that most children in this study can inhibit their own knowledge when making judgments about another person's beliefs, as well as their own past beliefs, and are able to hold two different representations of a certain situation simultaneously.

The results of the nonverbal transfer task demonstrated that more than half of the children in this study were able to attribute false beliefs to an animated actor and to implicitly, by shifting their gaze to a location, predict the actor's behavior based on its beliefs about the location of an object. The finding that many three- and four-year-olds passed this task furthermore shows that these children were able to follow the storyline of this transfer task, and were able to attribute a false or true belief to the actor based on the actor's visual view of the scene.

Almost all children failed the traditional transfer task, which is surprising considering it is not so very different from the nonverbal and non-animated transfer tasks. In order to pass this task a child needs to understand that another person can have a false belief and that this false belief influences the person's behavior, which most children demonstrated to understand in the nonverbal and non-animated transfer task. One difference between the traditional transfer task and the non-animated transfer task, and a possible reason why the children failed the traditional transfer task, is that this task is played out with dolls while the non-animated transfer task is not. It could be the case that children find it easier to attribute mental states to real people than to dolls. However, around half of the children passed the nonverbal transfer task which was also acted out with inanimate objects. If the children of this study failed the



traditional transfer task because they were unable to attribute mental states to inanimate objects, then they should also have failed the nonverbal transfer task. However, many passed the nonverbal transfer task, making it unlikely that the children in this study failed the traditional transfer task because they had difficulty attributing mental states to an inanimate object. Another possible reason why children fail the traditional transfer task, but not the non-animated transfer task is that in the non-animated transfer task the actor (who the child has to predict the behavior of) is not present at all, while in the traditional transfer task the actor is present most of the time. Although this seems to make the task easier at first sight because theorizing about the mind of another person who is not even there in the room seems more difficult than theorizing about the mind of an actor who is present, this might not be the case. In the non-animated transfer task the child has to predict the actions of another person who has not been present at the scene at all. In this task, the child needs to understand that the person was not there, therefore has a false belief, and consequently acts incorrectly. In the traditional transfer task the child is asked to predict the actions of an actor who has been present half of the time. In order to pass this task, the child has to remember what the actor did and did not see, attribute a belief to the actor based on this information, and predict the actor's behavior based on its mental state. This task thus requires one additional step; the child has to remember what the actor knows in order to make a correct judgment. This additional step might overload the information-processing capacity of young children, consequently making the task more difficult to pass.

The finding that more children pass the nonverbal transfer task than the traditional transfer task supports the idea that children fail the traditional transfer task because they have a limited information-processing capacity. Although these two tasks are very similar, having to give a verbal, elicited, response is, as mentioned before, probably more cognitively demanding than giving a nonverbal spontaneous response, causing more children to pass the nonverbal transfer task than the traditional transfer task. Supporting the idea that information-processing abilities play an important role in children's performance on theory of mind tasks is the finding that three-, four-, and five-year olds' ability to carry out concurrent mental activities is related to theory of mind performance (Gordon & Oslon, 1998). Furthermore supporting this suggestion is a previous finding that three-year-olds perform significantly worse on dual-processing tasks than four-year-olds (Gordon & Oslon, 1988). This could explain why the four-year-olds in this study performed better on the theory of mind tasks than the three-year-

olds. It is thus very likely that as children improve on their information-processing abilities, they begin passing more complex theory of mind tasks. This would explain why children scored so differently on different tasks and why almost none of the children passed the traditional transfer task. Compared to the other tasks, the traditional transfer task has a high cognitive load because in order to pass it, one has to remember the storyline, what the actor did and did not see and give an explicit response. This task thus requires more use of information-processing resources than the other tasks, in which the children have to remember less information and/or do not have to give an explicit response.

In summary, the results of the verbal and nonverbal theory of mind tasks indicate that three- and four-year-olds understand that their representation of reality is not always similar to that of other people. Around half of them were also able to predict another person's behavior based on the person's beliefs. The three- and four-year-olds in this study were able to represent mental states and around half of them were able to predict a person's behavior based on his or her mental representation, showing that they have a theory of mind. However, most of them failed the traditional transfer task, which is surprising considering the results of the other theory of mind tasks showed that many of these children have a theory of mind. Other mental processes, beside theory of mind, must therefore have influenced the results of the traditional transfer task. Verbal abilities may play an important role, however, most children were able to answer similar verbal questions in other tasks such as the non-animated transfer task. It was therefore suggested that children's information-processing abilities largely determine their performance on theory of mind tasks. Most children in this study demonstrated to have theory of mind understanding but nonetheless failed the more difficult traditional transfer task. Most likely, their information-processing skills were not developed enough yet to pass this task. This suggestion is in line with the *modular theory of theory of mind*, which states that children are born with a theory of mind module, and thus have a theory of mind, but fail theory of mind tasks because they lack abilities in other areas. The finding that most four-year-olds and many three-year-olds showed to have a fully developed theory of mind, yet failed the traditional transfer task supports this theory. This shows that they did not fail the traditional transfer task because they did not have a theory of mind, but because they lack abilities in other areas. Once children develop themselves in these other areas, such as their information-processing skills, their performance on the traditional transfer task will most likely improve as well.

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#### *5.4 Limitations*

Several limitations of this study should be recognized. During the nonverbal transfer task the doll did not always search at the location where it believed Bambi was hiding in order to avoid children using the behavioral rule: ‘people look for an object where they last saw it’. However, it could be that children continued using this rule, even though the doll acted incorrectly in half of the trials. If this is the case, the children of this study may have passed the nonverbal theory of mind task by using the rule ‘the doll searches for Bambi where it last saw it’. This does not require a theory of mind, only the ability to remember where the doll saw Bambi last. In everyday life, it is probably more likely that a child sees another person looking for an object at a location where he or she last saw it than at another location. It could be the case that this behavioral rule, learned from experiences in daily life, cannot be modified so easily. Further research examining whether young children use this rule, and, if so, how resistant to change this rule is necessary to rule out this alternative explanation of the looking behavior results of the nonverbal transfer task.

The nonverbal transfer task used in this study was designed in a way so that children could not use the situational cue of the actor leaving the scene to predict the actor’s behavior. However, the actor did turn around at the moment the actor’s belief was induced in half of the trials, which could still have served as a cue to help predict the actor’s behavior. Although the action of the actor turning around is a less obvious cue than the actor disappearing completely, this study cannot rule out the possibility that the children in this study used this cue to help predict the actor’s behavior. However, many children made correct action predictions in the first test trial they witnessed, suggesting that children did not learn to associate this situational cue with the actor’s behavior during the experiment. If children used this situational cue to predict the actor’s behavior they thus should have learned to make this association somewhere else. It is not very likely that children in their every-day life have learned that ‘people who have just turned around act incorrect’. Still, this alternative explanation cannot be ruled out completely without further research.

Another limitation of this study is that only three- and four-year-olds were tested on the theory of mind tasks used in this study. The perspective taking task was passed by almost all children, and was therefore probably too easy for this age group, while the traditional transfer

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task used in this study was passed by only a few children and therefore probably too difficult for this age group. These near-flooring and ceiling effects made it difficult to interpret some of the results found. In order to make a better estimation of the age at which children pass these tasks future research should use a sample with a broader age range.

## **6. Conclusion**

The results of this study suggest that three-, and four-year-olds have a theory of mind but nevertheless have problems passing the traditional transfer task. This failure does not stem from their inability to inhibit their own representation of reality when this is incongruent with someone else's representation or their own past representation, as shown by the unexpected content and non-animated transfer task. It was therefore argued that their failure on the traditional transfer task is most likely the result of the limited information-processing capacity of three- and four-year olds. This conclusion is supported by the finding that most children failed the traditional transfer task, but passed the nonverbal transfer task, which are very similar, but require a different response type. Having to give a spontaneous response is most likely cognitively less demanding than having to give an elicited response; hence more children failed the traditional transfer task. Also more children failed the traditional transfer task than the non-animated transfer task, of which the latter is cognitively less demanding because it does not require the child to remember what the other person did or did not see of the event shown. The children of this study did not fail the traditional transfer task because they lack a theory of mind, but because this task requires additional skills to be passed that the children of this study probably had not yet fully developed. In conclusion, this study suggests that theory of mind develops before the age of four and that children around the age of three fail the traditional transfer task because they have not fully developed other abilities necessary to pass this task, most likely their information-processing abilities.

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